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A structural model of cognitive-motivational variables as explanatory factors of academic achievement in Spanish Language and Mathematics

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Título: Un modelo estructural de variables cognitivo-motivacionales explicativas del rendimiento académico en Lengua Española y Matemáticas.

Resumen: En los últimos años se vienen desarrollando diversos modelos explicativos que tratan de analizar el valor predictivo de distintos factores en relación al rendimiento escolar, así como los efectos directos e indirectos que se producen entre ellos. Nuestro objetivo es contrastar un modelo estructural que integra algunas variables de tipo cognitivo y motivacional que influyen en el rendimiento de los alumnos en las dos áreas instrumentales básicas de nuestro currículo: Lengua Española y Matemáticas. Entre estas variables incluimos las aptitudes diferenciales, el autoconcepto específico, las orientaciones de meta, el esfuerzo y las estrategias de aprendizaje. La muestra está compuesta por 341 alumnos españoles de primer curso de Educación Secundaria Obligatoria. Empleamos distintas pruebas y cuestionarios para la evaluación cada una de ellas y aplicamos SEM para contrastar las relaciones del modelo inicial. El modelo propuesto obtiene un ajuste satisfactorio en las dos áreas estudiadas, siendo significativas la totalidad de las relaciones hipotetizadas. La aptitud matemática y verbal es la variable con mayor poder explicativo sobre el rendimiento académico. También destaca la influencia directa del autoconcepto específico sobre el rendimiento, las orientaciones de meta y el esfuerzo, así como la capacidad mediadora del esfuerzo y de las estrategias de aprendizaje entre las metas académicas y el rendimiento final.

Palabras clave: motivación; autoconcepto; aptitudes diferenciales; orientaciones de meta; estrategias de aprendizaje; análisis de ecuaciones estructurales; rendimiento académico.

Abstract: In recent years, several explanatory models have been developed which attempt to analyse the predictive worth of various factors in relation to academic achievement, as well as the direct and indirect effects that they produce. The aim of this study was to examine a structural model incorporating various cognitive and motivational variables which influence student achievement in the two basic core skills in the Spanish curriculum: Spanish Language and Mathematics. These variables included differential aptitudes, specific self-concept, goal orientations, effort and learning strategies. The sample comprised 341 Spanish students in their first year of Compulsory Secondary Education. Various tests and questionnaires were used to assess each student, and Structural Equation Modelling (SEM) was employed to study the relationships in the initial model. The proposed model obtained a satisfactory fit for the two subjects studied, and all the relationships hypothesised were significant. The variable with the most explanatory power regarding academic achievement was mathematical and verbal aptitude. Also notable was the direct influence of specific self-concept on achievement, goal-orientation and effort, as was the mediatory effect that effort and learning strategies had between academic goals and final achievement.

Key words: motivation; self-concept; differential aptitudes; goal orientation; learning strategies; structural equation analysis; academic achievement.

Introduction

Studying factors involved in the learning process is one of the most important scientific objectives in educational psychology, and is a fundamental tool for improving curriculum designs and students' academic results (Miñano & Castejón, 2008; Zeegers, 2004). In our case, given the huge diversity of explanatory factors, we set out to analyse the influence of certain cognitive and motivational variables that influence the academic achievement of adolescent students.

Two of the cognitive variables which have traditionally received most research attention in relation to academic achievement are general intelligence and specific aptitudes. It could be said that intelligence probably constitutes the most frequently studied factor in relation to academic achievement, and is one of the most stable factors in terms of predicting performance. However, magnitude values for the contribution of intelligence to determining achievement are of the order of moderate to medium-high, thus presenting considerable variation (Castejón & Navas, 1992; Navas, Sampascual, & Santed, 2003). Consequently, as mentioned previously, these studies have increasingly tended to include

other factors of a motivational nature, which regulate and mediate between the intelligence of each subject and their final achievement, such as goal orientations, causal attributions, self-concept, effort and task value. Thus, integrating both variable types provides a more realistic vision of the cognitive and motivational fabric that determines students' school performance; as stated by Pintrich (2003, p. 674), "understanding how motivational constructs explain the cognitive processes, integrating models of motivation and cognition".

In the learning process, goal orientations reflect the desire to develop, achieve and demonstrate competence in an activity, and can influence how students approach, respond to and commit to academic activities and other achievement experiences (Ames, 1992; Dweck & Leggett, 1988; Harackiewicz, Barron, & Elliot, 1998). Mastery-approach goals have been empirically related to improved academic achievement, together with other more adaptive motivational, cognitive and behavioural mediators within the learning process (Gehlbach, 2006; Harackiewicz, Barron, Pintrich, Elliot, & Thrash, 2002; Linnenbrink & Pintrich, 2000; Valle et al., 2009; Zimmerman, 2008), such as self-concept and self-efficacy (Long, Monoi, Harper, Knoblauch, & Murphy, 2007; Middleton & Midgley, 1997; Skaalvik, 1997), effort (Chouinard, Karsenti, & Roy, 2007; Elliot, McGregor & Gable, 1999; Linnenbrink & Pintrich, 2000; Turner, Thorpe, & Meyer, 1998) and significant learning strategies (Dupeyrat

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& Marine, 2005; Elliot & McGregor, 2001; Grant & Dweck, 2003; Harackiewicz et al., 2000; Kolic-Vehovec, Roncevic, & Bajanski, 2008; Shih, 2005; Valle, Cabanach, Núñez, & González-Pienda, 2006). There also seems to be considerable consensus regarding the notion that mastery and performance-avoidance goals are those which correlate more closely to worse achievements in studies. However, there is less empirical evidence on the role of performance-approach goals in academic studies. Thus, whereas some consider it a somewhat non-adaptive goal that tends to be associated with unsatisfactory results (Dupeyrat & Marine, 2005), others do not consider it non-adaptive, particularly when compared with task avoidance (Butler, 2006; Midgley et al., 2001), or that it can be more or less adaptive depending on the circumstance (Pintrich, 2000b). To rectify this controversy, Senko and Harackiewicz (2005) state that, whereas performance-approach goals are directly related to students' school achievement level, mastery-approach goals relate more to interest, effort and persistence, so that the effect of this orientation on performance is mediated by the appropriate use of self-regulated learning strategies (Daniels et al., 2009; Valle et al., 2003a).

With regard to self-concept, the vast majority of studies obtain a statistically significant relationship between self-concept and academic achievement, particularly at more specific levels (Choi, 2005; González-Pienda et al., 2003), even obtaining the highest predictive ability from amongst the set of motivational variables (Mills, Pajares, & Herron, 2007; Robbins et al., 2004; Spinath, Spinath, Harlaar, & Plomin, 2006). It thus seems obvious that a subject's active involvement in the learning process increases when he/she feels self-competent, that is, when he/she trusts his/her own abilities and has high expectations of self-efficacy (Miller, Behrens, Greene, & Newman, 1993; Zimmerman, Bandura, & Martínez-Pons, 1992). In this case, specific self-concept is comparable with self-efficacy, as the latter includes organising and implementing courses of action (Bandura, 1986), which is a more specific and situational view of perceived competence, and is used in relation to a goal of some kind, which again shows that self-efficacy is more specific and situational in nature (Pietsch et al., 2003; Pintrich & Schunk, 2002). Nevertheless, determining a relationship between self-concept and performance is problematic, because of the difficulty in conceptualising self-concept, on the one hand, and on the other because of the reciprocal effects that occur within these relationships (Eccles, 2005), which are illustrated in the models put forward by Marsh et al. (Guay, Marsh, & Boivin, 2003; Marsh & Koller, 2004; Marsh, Trautwein, Ludtke, & Koller, 2005; Marsh & Craven, 2006; Marsh & O'Mara, 2008). Similarly, self-concept and self-efficacy are closely related to other motivational variables, such as goal orientations (Spinath & Stiensmeier-Pelster, 2003), causal attributions (Piñero et al., 1999) and cognitive variables such as learning strategies (Rodríguez, Cabanach, Valle, Núñez, & González, 2004; Thomas et al., 1993).

Meanwhile, the suitable use of cognitive and metacognitive strategies can turn "taught" material into "learnt" material. In this way, the suitable use of deep learning strategies is positively related to academic performance (Chiu et al., 2007; Martín, Martínez-Arias, Marchesi, & Pérez, 2008; McKenzie, Gow, & Schweitzer, 2004; Yip, 2007), though some authors have related them less to grades achieved but rather to the quality and significance of the learning. Nevertheless, as García and Pintrich state (1994), the use (rather than the knowledge) of this kind of strategy is mediated by or related to student motivation. For this reason, in most of the various structural models that have considered cognitive and motivational variables to explain academic achievement (in the line of causality) learning strategies come behind motivational variables such as self-concept, causal attributions or students' goal orientations (Bandalos et al., 2003; Fenollar, Román, & Cuestas, 2007; Ruban & McCoach, 2005; Simons, Dewitte, & Lens, 2004; Swalander & Taube, 2007; Zhang & Richarde, 1999), playing a particularly relevant role in cases of intrinsic motivation. Furthermore, a reciprocal relationship can be observed between learning strategies used by students and the effort and interest that they show in performing school tasks (Meltzer et al., 2004).

Hypothetical model

The structural model considered aims to study to what extent the variables of motivation interact with other more cognitive variables, such as intelligence or learning strategies, in predicting school performance, which highlights the importance of studying aspects of self-regulated learning, together with intellectual skills or aptitudes, to develop a common theoretical framework (Grigorenko et al., 2009). However, after analysing the more recent structural models that have integrated cognitive and motivational variables (Bandalos et al., 2003; Fenollar et al., 2007; McKenzie et al., 2004; Swalander & Taube, 2007; Valle et al., 1999, 2003a; Zhang & Richarde, 1999), it is observed that they do not include variables related to intelligence or differential aptitudes. Hence, although the evolution of the research has shifted from considering intelligence as one of the main, if not the main, determining factor in academic achievement, to considering other personal factors with a volitive or motivational nature as predictors of the latter, it becomes necessary to: a) attempt to test the extent to which general intelligence or individual skills affect motivational variables; b) analyse whether the effect of the former on performance is mediated by the individual's motivation; and c) test whether motivational variables contribute to explaining academic achievement beyond general intelligence. Consequently, this paper aims to answer these matters.

In addition, the initial model was contrasted for the two basic core skills: Spanish Language and Mathematics. This comparison facilitated an analysis of whether students' cognitive-motivational performance is the same for each of the two most important subjects on the curriculum.

Thus, as Figure 1 shows, specific aptitudes are expected to have a direct effect on goal orientations, which is positive for mastery-approach goals and negative for performance-approach goals. Thus, given that this is also a cognitive variable, it is expected to have a direct positive influence on the effective use of learning strategies (Ruban & McCoach, 2005), though this effect will also be mediated by the variables that refer to goals and the effort made. Finally, aptitudes are expected to have a direct and positive effect on final academic achievement.

Meanwhile, academic self-concept will affect mastery-approach goals, and performance-approach goals (Valle et al., 1999, 2003). Therefore, as stated previously, this will have a positive effect on effort (Fenollar et al., 2007; Muis & Franco, 2009), as it is expected that students with greater self-concept will have greater involvement in their school tasks.

With regard to goal orientations, students with high scores in mastery approach will make a greater effort and deploy more significant learning strategies, which will mean high levels of academic achievement (Bandalos et al., 2003; Valle et al., 1999). However, students with high scores in performance-approach goals will only achieve satisfactory grades if they make an effort (Long et al., 2007), and use learning strategies to a sufficient degree. For this reason, it is expected that in this case the indirect effect on final performance through effort and strategies will be positive, whereas the direct effect will be negative (Phan, 2009).

Finally, effort is expected to have a positive effect on academic achievement (Corbiere, Fraccaroli, Mbekou, & Perron, 2006), both directly and indirectly, through the use of significant learning strategies.

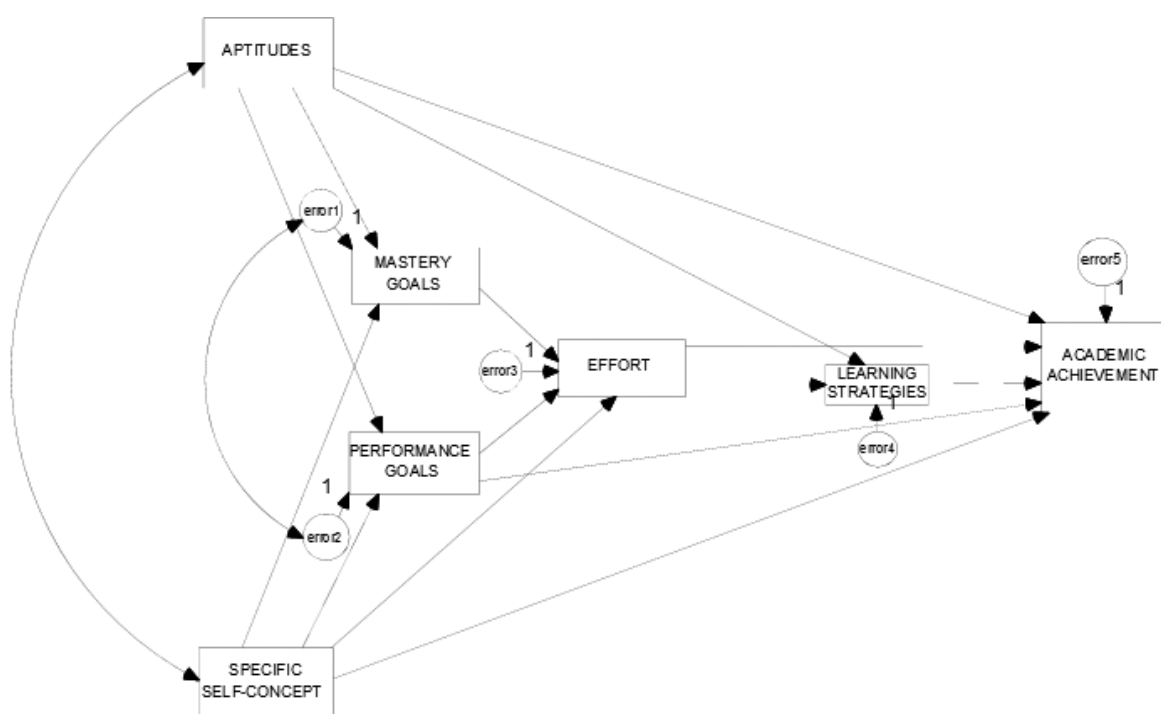


Figure 1. Hypothetical model.

Method

Participants

A total of 369 students from the first academic year of compulsory secondary education in one private and three Spanish state schools took part. Of these, 28 had to be excluded due to errors or omissions in their answers, or because they did not have sufficient command of Spanish. This gave a total of $n=341$. Conglomerate sampling was employed, with the group-class as the sampling unit. The gender split was such that 174 students (51%) were girls and 167

(49%) were boys. The majority (65.99%) were at state schools, with the rest (34.01%) at private schools.

Variables and instruments

The structural model included the following variables:

- *Specific self-concept*: These variables were measured using the ESEA-2 [Self-Concept Evaluation Scale for Adolescents] produced by González-Pienda et al. (2002). This questionnaire is a Spanish adaptation of the SDQ-II by Marsh (1990), validated in a study with 503 students in compulsory secondary education. It comprises 70 items measuring

11 specific self-concept dimensions, to which students must answer on a Likert scale from 1 to 6, depending on the extent to which they agree or disagree with each statement. In the authors evaluation work, all obtain Cronbach's alpha values of .73 to .91. For this study, we only selected verbal and math self-concept factors, with alpha values of .82 y .89, respectively.

- *Goal orientations and effort*: These variables were evaluated using the MAPE [Motivation Towards Learning Questionnaire] by Alonso and Sánchez (1992). The MAPE is comprised of 72 items used to determine the most relevant aspects of student motivation towards academic achievements, to which students must answer YES or NO depending on whether or not they agree with each statement. From these 72 items, the authors obtained a first-order eight-factor and second-order three-factor structure. For this paper, we took only the second-order factors, which are conceptually equivalent to mastery-approach orientation, performance-approach orientation and effort, which have in our sample values of Cronbach's alpha of .64, .67 and .51, respectively.
- *Learning strategies*: To evaluate this variable, we used the CEA [Learning Strategies Questionnaire], produced by Beltrán, Pérez, and Ortega (2006). The test evaluates four large scales or processes, into which the following strategies are grouped: awareness, development, personalisation and metacognition, from which it's only used in this study the own cognitives and metacognitives scales. To obtain the different scores for these three scales, students answered a total of 50 items, indicating the extent to which each formulated strategy was true, on a Likert scale from 1 to 5, obtaining in our sample values of alpha reliability of .85, .87 and .70, respectively. From the sum of the scores from these three scales, an overall score in learning strategies was obtained, which was then included in the study.
- *Verbal/Maths aptitude*: To obtain the data from these variables, we used the BADYG-M [Set of Differential and General Aptitudes] by Yuste, Martínez, and Galve (2005). This is made up of nine sub-tests, six of which are basic, from which scores for mathematical aptitude and verbal aptitude were obtained. The six basic sub-tests consist of 32 elements, each with five answer choices. Like this, the sum of the verbal tests cause the punctuation of the Verbal aptitude variable with a Cronbach's alpha of .88, while the sum of the numeric and spatial tests cause the punctuation of the mathematical aptitude variable with a value of .79.
- *Academic achievement*: This variable was evaluated using the results obtained by the students' end-of-year assessment in Spanish Language and Mathematics, respectively, gathered from the various schools' records. These scores were recorded on a scale of 0 to 10.

Procedure

The data gathered were obtained in the classroom and during school hours. The subjects participated voluntarily

and with the informed consent of their parents or legal guardians, and at all time guarantees were given regarding the confidentiality of the results obtained. The tests were run simultaneously in the various schools by several specialist collaborators, who received prior general training on how to apply the various instruments (purpose, instructions, times, etc.). The study was conducted during the academic year, from November to March, over four sessions that each lasted an hour, with the exception of the Aptitudes study, which took two hours.

Data analysis

From the correlation matrix, structural equation analysis was used, following the maximum likelihood (ML) estimation method. The main objective of the research was to test a set of explanatory relationships between the variables which, according to a certain theoretical framework, have a significant influence on students' school achievement in cognitive and motivational terms.

Before applying SEM, we particularly ensured that the normality and linearity were met. To ensure this hypothesis we analyzed on one side, the values of skewness and kurtosis (Table 1) and, on the other side, the referred scatterplots that distribute the dependent variables along the independent variable for each relationship.

Table 1. Means, standard deviations, skewness and kurtosis of the variables included in the models.

Variables	Mean	SD	Skewness	Kurtosis
1. Maths aptitude	27.62	9.25	0.37	-0.32
2. Verbal aptitude	32.49	12.13	-0.01	-0.81
3. Maths self-concept	3.76	1.49	-0.23	-1.00
4. Verbal self-concept	3.93	1.17	-0.33	-0.51
5. Mastery-approach goals	18.30	5.56	-0.46	-0.25
6. Performance-approach goals	9.09	3.36	-0.02	-0.54
7. Effort	15.97	5.48	-0.10	-0.47
8. Learning strategies	161.79	29.42	-0.02	-0.43
9. Academic achievement in Maths	5.70	2.34	-0.05	-0.76
10. Academic achievement in Spanish Language	6.13	2.13	-0.02	-0.57

All of the models were analysed under the assumption of multivariate normal distributions, as skewness and kurtosis values for the variables were in a range of ± 1 . Furthermore, the method of maximum likelihood used in AMOS 7 is robust for departures from normality, especially if the sample is large and the skewness and kurtosis values are not extreme, i.e., skewness values $> |2|$ and kurtosis values $> |7|$ (West, Finch, & Curran, 1995).

Equally, the scatter plots indicate that there is linearity between the variables studied, as the points show the same dispersion throughout all the data values, with no regular or curved pattern, which would indicate a possible lack of linearity or the presence of heterocedasticity.

Finally, the diagnosis of outliers from the multivariate viewpoint, evaluated using the Mahalanobis distance, indicates that there are no outliers, as none lies below the sig-

nificance threshold value of .001 (Hair et al., 1998). The AMOS 7.0 programme was used for all analyses.

Results

Model goodness of fit

We used absolute fit indexes to ensure the models fit, determining the extent to which the models predict the observed covariances matrix. In this way, in Mathematics, statistic χ^2 (5, $N=341$) reaches value of 4.166, $p=.526$, whilst in Spanish Language χ^2 (4, $N=341$) = 6.028, $p=.197$, once an extra pathway had been added to the model comprising the pair verbal self-concept and learning strategies, with the aim of obtaining a better fit for the model. However, χ^2 may not be reliable for samples of more than 200 subjects

(Bagozzi & Yi, 1988; Bollen, 1989), because the value is a direct function of sample size, making it preferable to analyse alternative indexes. Thus, the Goodness of Fit Index (GFI) value is .997 for Mathematics and .995 for Spanish Language, indicating that the models fit the data optimally. The Root Mean Square Error of Approximation (RMSEA), is .000 for Mathematics and .039 for Spanish Language, which tells us that the fit is satisfactory. Similarly, the normed fit and Tucker-Lewis indexes (NFI and TLI) are higher than .95 in both cases, and the comparative fit index (CFI) is equal to .999 and .995, respectively. The percentage variance explained in the criterion variable is 50% ($N=341$, $\alpha=.01$, $P=.99$) in the case of Mathematics, and 43% ($N=341$, $\alpha=.01$, $P=.99$) in Spanish Language. All these values are detailed in Table 2.

Table 2. Fit indexes of the final models.

Model	χ^2	df	χ^2/df	p	GFI	RMR	NFI	TLI	CFI	RMSEA	R ²
Maths	4.166	5	0.833	.526	.997	1.706	.992	1.007	1.000	.000	.502
Spanish Language	6.028	4	1.507	.197	.995	2.538	.987	.976	.995	.039	.429

Evaluation of individual parameters

With regard to the relationships between the variables, in Mathematics all the relationships proposed in the hypothetical model are significant at a level of $p<.05$ (Figure 2). The biggest standardized regression weighting is reached in maths aptitude-academic achievement ($\beta=.492$, $p=.000$), followed by effort-learning strategies ($\beta=.420$, $p=.000$), and maths self-concept-academic achievement ($\beta=.276$, $p=.000$). Similarly, all the direct effects are positive, except for those produced by maths aptitude on performance-approach goals ($\beta=-.132$, $p=.0018$), and by performance-approach goals on academic achievement in Maths ($\beta=-.163$, $p=.000$). The statistically significant indirect effects are those produced by maths aptitude on achievement through learning strategies ($\beta=.040$, $p=.001$); by maths self-concept on effort through mastery-approach goals ($\beta=.113$, $p=.001$), and on learning strategies ($\beta=.154$, $p=.000$) through effort; also statistically significant were the indirect effects of goal orientations on learning strategies ($\beta=.109$, $p=.001$; $\beta=.103$, $p=.001$) and on final performance ($\beta=.036$, $p=.002$; $\beta=.034$, $p=.002$), through effort, as well as the effect produced by effort on academic achievement through learning strategies ($\beta=.042$, $p=.022$).

With respect to Spanish Language, all the relationships proposed in the hypothetical model are significant at a level of $p<.05$, except for the effect produced by verbal self-concept on performance-approach goals and the effect of learning strategies on academic achievement in Spanish Language (Figure 3). As was the case for Mathematics, the biggest standardized regression weighting is reached in verbal aptitude-academic achievement ($\beta=.442$, $p=.000$), followed by effort-learning strategies ($\beta=.366$, $p=.000$). All the direct effects are positive, except for those produced by verbal aptitude on performance-approach goals ($\beta=-.149$, $p=.007$), and those produced by performance-approach goals on academic achievement ($\beta=-.110$, $p=.011$). In this instance, the statistically significant indirect effects are those produced by verbal aptitude on academic achievement in Language through learning strategies ($\beta=.029$, $p=.007$); by academic self-concept on effort through mastery-approach goals ($\beta=.079$, $p=.001$), on learning strategies ($\beta=.134$, $p=.001$) and final performance ($\beta=.065$, $p=.002$) through effort; also statistically significant were the indirect effects of goal orientations on learning strategies ($\beta=.098$, $p=.001$; $\beta=.099$, $p=.001$) and on final performance ($\beta=.047$, $p=.001$; $\beta=.047$, $p=.001$), through effort.

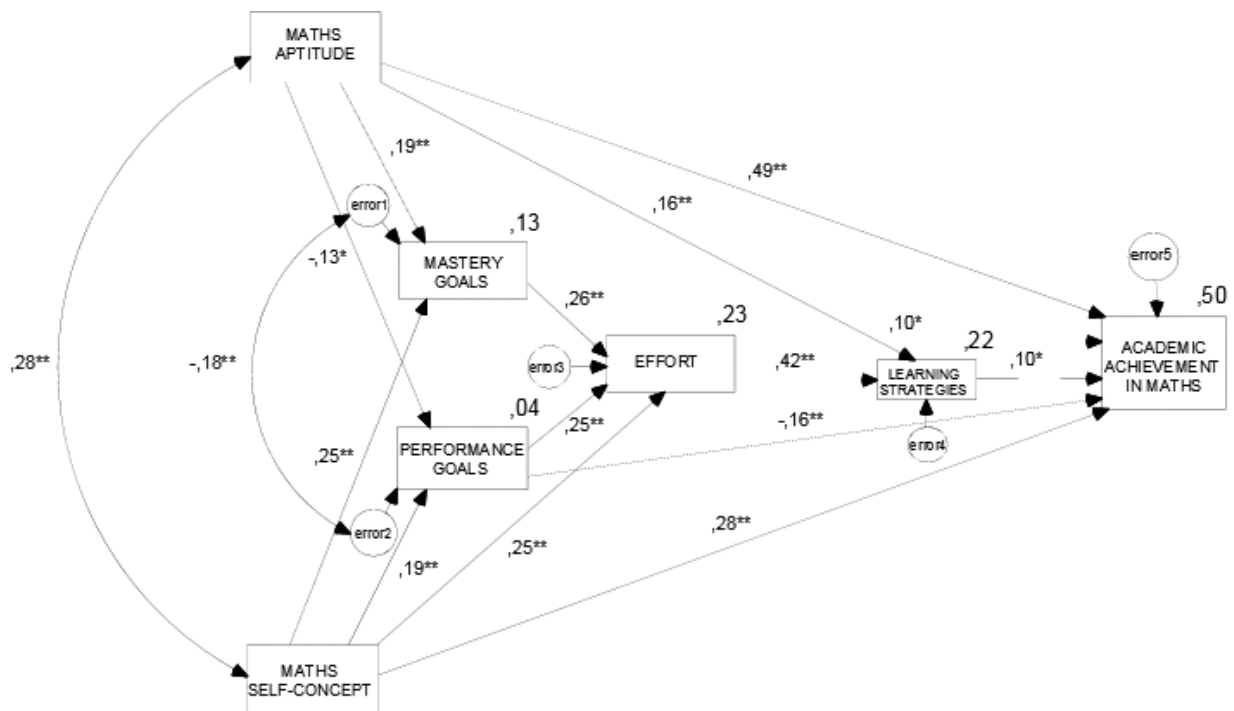


Figure 2. Graphic representation of the results of the structural model studied in Maths.
 $*p < .05$; $**p < .01$.

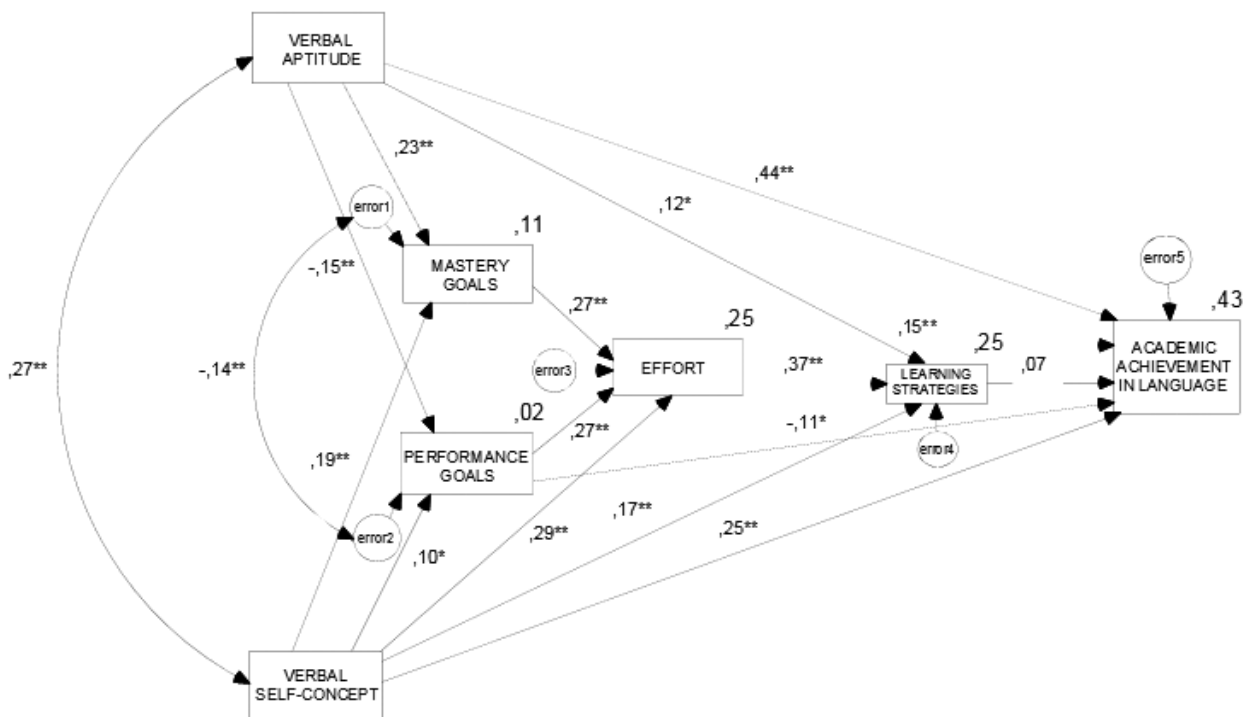


Figure 3. Graphic representation of the results of the structural model studied in Spanish Language.
 $*p < .05$; $**p < .01$.

Finally, in both instances, the correlations between the exogenous variables aptitudes and self-concept are positive

and statistically significant. The correlation between the two goal orientations is also significant, but negatively.

Discussion

As stated in the Results sections, the models considered obtained a satisfactory data fit, especially in Mathematics, where an optimum fit was attained. Almost all the pathways included are significant, explaining 50% of the variance in academic achievement in Mathematics and 43% in Spanish Language. However, in the analysis of such an explanation, two possible limitations should be taken into account, relating to the characteristics of the phenomenon measured. The first of these is the evaluation itself of learning. In effect, even though the term “academic achievement” is synonymous with academic grades, it is usually the case that these grades are only an institutional evaluation of the products of learning (Biggs, 1989) and less of having achieved profound and significant learning (Navas et al., 2003; Valle et al., 2003a). Thus, whereas achieving significant learning is usually associated with optimal levels of performance, optimal levels of performance do not always produce significant levels of learning. Secondly, it should be remembered that education has a multi-causal origin, and a lower percentage of explained variance is therefore normal when there is a limited number of predictive variables.

However, we have to take into consideration the limitations that the causality concept presents if the variables are not measured at least two different times (Marsh & Craven, 2006; Marsh & O'Mara, 2008).

As considered in the initial model, differential aptitudes have a significant influence on students' goal orientations and on the appropriate use of learning strategies. Thus, whereas students with greater ability are orientated towards mastery, students with more limited abilities are more performance-goal orientated. This conclusion seems obvious, particularly when considering that, on the one hand, a mastery-goal orientation means a much greater investment of a student's cognitive and metacognitive abilities, and that, on the other, the very tools of aptitude measurement contain an important influence of crystallized intelligence (Catell, 1971, 1987; Yuste et al., 2005), which in short means that they are markedly academic in nature. Thus, based on a circular relationship, if it is expected that mastery-orientated students will achieve better academic results, these positive results will be associated with better scores in the evaluation of aptitudes, which, as stated previously, will have a significant influence on students' goal orientations. To summarize, even though the high direct explanatory power of aptitudes in academic achievement is confirmed once again, it can also be observed that this effect is influenced by other motivational variables such as goal orientations, effort and self-concept, which also explain a variance percentage in addition to the academic achievement prediction when the effects of intelligence or aptitudes are controlled.

Similarly, goal orientations have a significant effect on the effort made by students in school tasks, which confirms the initial hypothesis. However, contrary to expectations (Senko & Harackiewicz, 2005), both types of goals are posi-

tive ones, and obtain very similar scores. This fact may be explained by the considerations of multiple goals. According to such considerations, students do not have one kind of orientation or another, but rather can have both at the same time (Valle et al., 2003b). Indeed, research results show greater academic achievement particularly in students with a high level of orientation towards learning, and a moderate/high level towards performance (Barron & Harackiewicz, 2000, 2001; Bong, 2009; Chia, Wang, Tan, Ee, & Koh, 2009; Harackiewicz et al., 2002; Midgley et al., 2001; Pintrich, 2000a,b). Similarly, it can be observed that in the case of performance-goal orientation, only students that make a greater effort and have greater involvement in school tasks achieve positive academic results, which is why the indirect effect on performance through effort and the use of learning strategies is positive, and the direct effect of this orientation on final performance is negative.

With regards to specific self-concept, this has a significant influence on students' goal orientations and on the effort made. However, even though according to the initial hypothesis this relationship was expected to be negative in the case of performance-goal orientation (Middleton & Midgley, 1997; Pintrich, 2000b; Skaalvik, 1997), the results show that students with a positive self-concept can be performance-goal orientated, although to a lesser extent, which coincides with the study by Bandalos et al. (2003). Similarly, unlike the results obtained by Fenollar et al. (2007), it can again be observed that students with a greater specific self-concept make a greater effort in tasks than classmates with a lower self-concept (Schmidt, 2005), as they have a greater degree of confidence and security in their own abilities. It can also be observed, again, that there is a close relationship between academic self-concept and students' performance.

In line with the initial model, effort has a positive influence on students' academic achievement, both directly and indirectly through learning strategies. Thus, the appropriate use of these strategies is mainly determined by two variables: on the one hand, by a pupil's greater or lesser predisposition to effort, and on the other, by the cognitive aptitudes of the corresponding subject matter.

However, although the final adjustment of the model was satisfactory in the two areas studied, to ensure greater validity of the results a further measurement of learning strategies would have been helpful to compare the possible effect of desirability, which tends to reflect this variable when assessed through self-reports. Similarly, although the literature is clear on their maladaptive role, goal avoidance orientations could have been included for confirmation. At the same time, one of the limitations of the study would be the lack of reliability showed by the scales of the questionnaire of goals and effort. Finally, it would also have been useful to have evaluated intelligence not through a differential skills test but through a *g* factor test, which would have provided an intelligence score less contaminated by academic aspects, as these are included in some of the performance scores.

Finally, with regard to future research, it would be useful to analyse whether the models considered are reproduced according to relevant differential criteria in students, by subdividing the sample using a multi-group analysis in terms, for example, of factorial invariance. Thus, through a comparison of causal structure invariance it would be possible to determine whether equivalence exists between the causal structure of multiple samples and different groups (Lévy & Iglesias, 2006), classified according to differential criteria such as age, gender or previous achievement. Similarly, this model should be considered with the inclusion of other particularly relevant cognitive or motivational variables, such as causal attributions or students' expectations, in order to obtain a more complete vision of all the intrapersonal variables involved in the learning process.

Conclusions

1. Although aptitudes have once again been shown to have an important role in explaining academic achievement, the results of this study also demonstrate the mediatory nature of some motivational constructs which modulate their effects. Therefore, special attention should be paid when designing a school curriculum to develop programmes to improve motivation, which would help students optimize their cognitive resources.
2. In the two core skills in the curriculum (Language and Mathematics), students deploy similar cognitive-motivational resources, although in the case of Mathematics the predictive worth of cognitive variables

(mathematical aptitude and learning strategies) is slightly higher than for Spanish Language. Thus, taking into account that good performance in Language is essential for improved access to learning in any other subject matter, due to its instrumental nature, it is encouraging to observe that aptitude variables have a lower weighting, which helps to justify even further the consideration of pupils' motivational characteristics in the teaching-learning process.

3. As has been the case in many previous studies, academic self-concept has proved to be the most influential motivational variable when explaining achievement in the two subjects. This indicates once again that student achievement, commitment and effort in the learning process increases when students feel self-competent, that is, when they have confidence in their own abilities and capacities. Therefore, in the process of teaching, special care should be taken with the transmission of individual expectations, with attributing success or failure, and with the achievement, by all students, of a minimal experience of success, as the most important teaching tools for improving and consolidating the most realistic and adaptive self-concept possible. In this sense, adaptations of the curriculum towards a higher focus on diversity have an important justification.

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